LEVEL II

LOWER HUDSON RIVER BASIN

3 NW

MUSCOUT DAM
WESTCHESTER COUNTY
NEW YORK
INVENTORY Nº 61

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

APPROVED FOR PUBLIC RELEASE;
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CONTRACT NO. DACW 51-78-C-0035

NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1978

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

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Muscout Dam
Lower Hudson River Basin, Westchester County, NY
Inventory No. N.Y. 61

5. TYPE OF REPORT & PERIOD COVERED

Phase I Inspection Report
National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER

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10 John B./Stetson

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National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Muscout Dam
Westchester County
Croton River
New Croton Reservoir

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Muscout Dam was judged to be safe.

393 970 JCB

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam Muscoot Dam NY61

State Located New York
County Located Westchester
Stream Croton River
Date of Inspection July 27, 1978

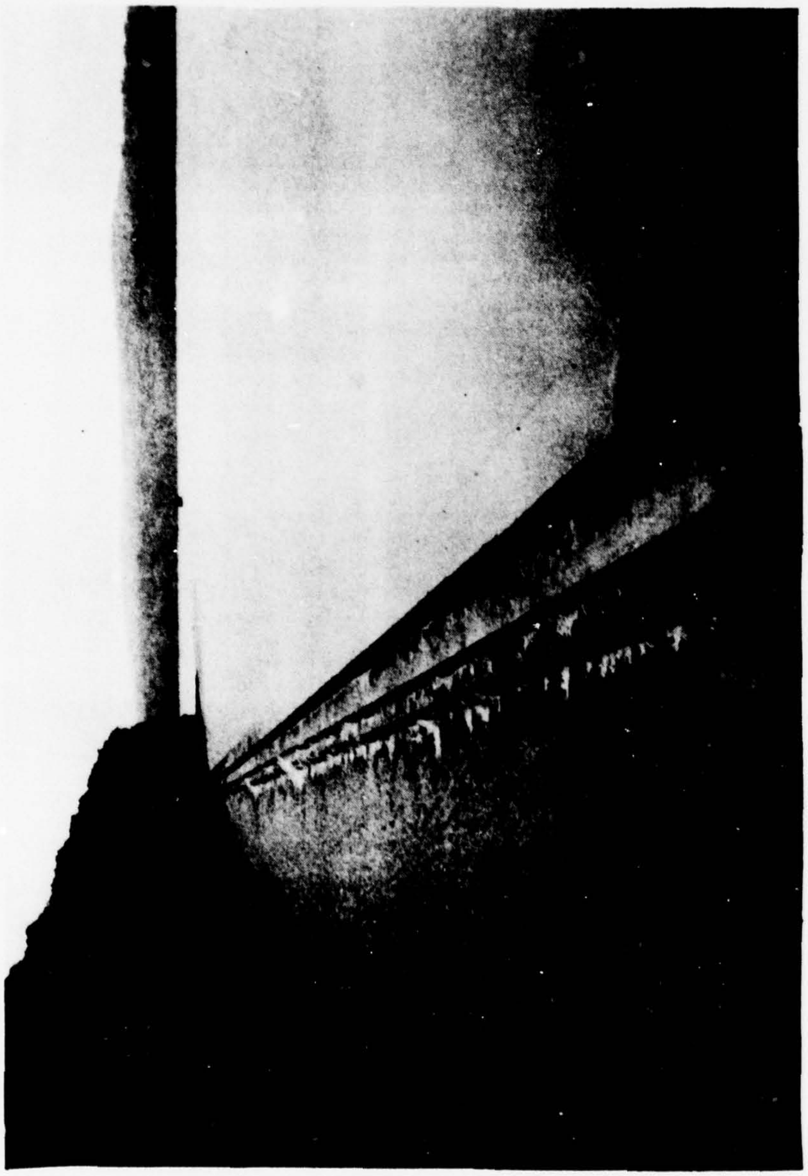
ASSESSMENT OF
GENERAL CONDITIONS

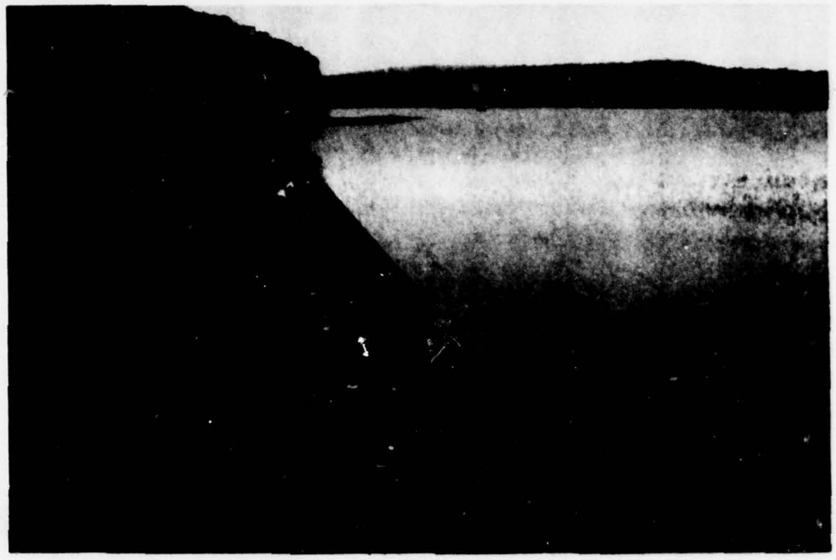
The Muscoot Dam is a partially submerged masonry structure which rises 29 feet high above the reservoir bottom. The dam is located in the middle of the New Croton Reservoir and was constructed in 1906. Nothing has been determined to deem this dam unsafe under normal operating conditions.

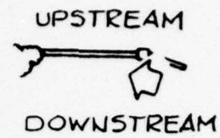
Dale Engineering Company

John B. Stetson, President

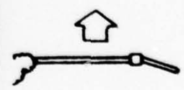
Approved By: Col. Clark H. Benn
New York District Engineer
Date: 19 September 1978







1. View across weir dam.



2. View of reservoir above dam.

3. Closeup of flow over dam.

4. View from below dam.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - MUSCOOT ID# - NY61

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and The New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Muscoot Dam and appurtenant structures, owned by New York City, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

This Phase I inspection report does not relieve an owner or operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Muscoot Dam is a masonry dam with a maximum height of 55 feet. The maximum height above the downstream river bed is approximately 29 feet. The dam is 1,130 feet long and has a thickness at the base of 38-1/2 feet. The width at the top of the dam is 5 feet.

The entire top length of the dam serves as a spillway to allow flow from the impoundment into the New Croton Reservoir which is located at the downstream face of the dam. A gate house is located at the southern end of the dam and controls the flow from the Muscoot impoundment into the New Croton Reservoir. Flow is controlled through six 2 foot by 8 foot sluice gates which operate from the gate house.

b. Location

Muscoot Dam is located in the Town of Bedford and in the Town of Somers in Westchester County, New York.

c. Size Classification

The maximum height of the dam is approximatley 29 feet above finished grade of the reservoir. The storage volume of the dam is approximately 10,750 acre feet. Therefore, the dam is in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The New Croton Reservoir which receives flow from the impoundment of the Muscoot Dam has a pool elevation four feet lower than the impoundment of the Muscoot Dam. The New Croton Dam discharges into the Croton River. The failure of the Muscoot Dam could cause excessive flows into the New Croton Dam, which if it failed, it would cause flows in the Croton River and severe damage to residential and industrial development along the Croton River. Under normal conditions however, there is little head in the reservoir with little threat to the New Croton Dam. Therefore, the dam is in the significant hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the City of New York, Bureau of Water Supply.

f. Purpose of Dam

The dam is an integral part of the Water Supply System of the City of New York. Water from the Croton System is used by the City for drinking water purposes. The Muscoot Dam was originally constructed to maintain water levels in the shallow portions of the reservoir upstream from the New Croton Dam. Prior to its construction, water level fluctuations provided breeding places for mosquitos. The Muscoot Dam was constructed to eliminate this Public Health hazard.

g. Design and Construction History

Construction of the Muscoot Dam began in May of 1901. Work progressed very slowly and construction period was extended many times. On January, 1904, the Contractor stopped all work for the winter. In February, the Aqueduct Commissioners declared the contract abandoned and stopped the remaining work. Bids were received for finishing the dam in April, 1904 and work was completed in January, 1906. The dam was completely constructed of masonry except for a short section, 68 feet long, south of the gate house which was built on the bank of the river. This portion consisted of a masonry core wall and an earth bank on each side sloping towards the river. The dam was founded on rock with the exception

of a stretch of about 55 lineal feet which was founded on hard pan. Each of the coping stones was anchored to the masonry by twisted steel rods. The whole dam from the northerly end to the gate house acts as an overflow weir. Its crest is 6 feet below the assumed highest water level in the reservoir (Ref. 3). During the construction of the Muscoot Dam, the Croton River Valley was widened from 300 feet to 400 feet wide at a point just below the Muscoot Dam. This was done to improve the hydraulics in this section of the Reservoir.

h. Normal Operational Procedures

The Muscoot Dam is visited periodically by employees of the New York City Bureau of Water Supply. The gate house is used to control flow into the New Croton Reservoir. At present, copper sulphate is being added at the gate house to control algae growth in the New Croton Reservoir. Water levels in both the New Croton Reservoir and the Muscoot impoundment are manipulated during the winter months to kill plant life which flourishes in the shallow areas of the impoundments.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the Muscoot is 316 square miles.

b. Discharge at Dam Site

No discharge records are available at this site.

Computed Discharges: (Dam acts as weir)

Ungated spillway, PMF	182,000 cfs
Ungated spillway, 1/2 PMF	96,000 cfs

c. Elevation (feet above MSL)

Top of dam (at gate house)	210
1/2 PMF discharge	209
Maximum pool - PMF discharge	214
Spillway crest	200
Stream bed at centerline of dam	169

d. Reservoir

Length of normal pool	Not computed

e. <u>Storage (Above Spillway)</u>

Top of dam	10750 acre feet
1/2 PMF surcharge	10000 acre feet
PMF surcharge	16000 acre feet

f. <u>Reservoir Surface</u>

Spillway pool	1266 acre

g. <u>Dam</u>

Type - Masonry.
Length - 1130 feet.
Height - 29 feet (53 feet to foundation).
Freeboard between normal reservoir and top of dam - 0.0 feet.
10.0 feet at gate house.
Top width - 5 feet.
Side slopes - 1 horizontal to 2 vertical.
Zoning - Not applicable.
Impervious core - None. See Section 1.2.g.
Grout curtain - No information.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information available for review of the Muscoot Dam included:

1) References 2, 3 and 5 in Appendix E.

2) Plans and maps in Figures 1 through 4.

3) Sheet Table No. 7, File 149, entitled "Data Pertaining to Storage Reservoirs of New York City Water Works - Croton System".

2.2 CONSTRUCTION

Information on construction can be obtained from New York City Board of Water Supplies Archives and to a limited extent, References 2, 3 and 5 of Appendix E. Salient points on the construction activities are described in Section 1.2 of this report.

2.3 OPERATION

See Section 4.

2.4 EVALUATION

The engineering data and references reviewed indicate the New York City structures built during this period were designed and constructed very carefully.

SECTION 3 - VISUAL INSPECTION

3.1 SUMMARY

a. General

The visual inspection of Muscoot Dam took place on July 27, 1978. The dam is a partially submerged masonry dam structure that visually looks like a weir across the total reservoir width.

b. Dam

Due to the fact the dam was largely submerged and that the spillway was discharging across the total length of the dam, the inspection team could not get out on the dam to inspect the dam surface. The top of the dam appears to have maintained its alignment. The exposed portion of the dam visually conforms to the plans.

c. Spillway

The entire top of the dam is the spillway. Portions visible to the inspection team (see Photographs 1 and 3) did not exhibit any problems. Photograph 3 suggests that the masonry joints on top of the dam may need some pointing and/or grouting.

d. Appurtenant Structures

The gate house was inspected (the structure can be seen in the right position of Photograph 4). Six sluice gates control the flow. One of the gates is jammed in the open position. The other five gates are operable.

e. Downstream Channel

The downstream channel is in the waters of the New Croton Reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. The dam and reservoir are owned by the New York City Bureau of Water Supply and are maintained by the staff of the Croton Division located in Katonah, New York which is nearby the dam. It is the staff's responsibility to maintain and operate the facility under the direction of the central office in New York City. During normal condition, the water surface elevation of the reservoir is at the spillway crest. Flow through the structure (below the dam crest) is controlled through six 2 foot by 8 foot sluice gates which operate from the gate house. At present, copper sulphate is being added at the gate house to control algae growth below in the New Croton Reservoir. Water levels are lowered in the winter to kill plant life which flourishes in the upper shallow impoundment areas.

4.2 MAINTENANCE OF DAM

The dam is maintained by the Croton Divisions full-time maintenance staff which has full capability in operation and maintenance engineering for the facility.

SECTION 5 - HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data

For this report, no information relevant to the hydrologic and/or hydraulic design for the dam was available. Analysis provided in Appendix C was performed utilizing information obtained from construction documents and other general sources of information listed in the reference section of this report.

Visually the dam appears as a simple weir structure across the New Croton Reservoir. The spillway elevation for Muscoot is 4 feet above that of New Croton Dam and Reservoir downstream. The dam, which is approximately 29 feet high (53 feet in height structurally to its foundation) was built in the early 1900's to control mosquitoes in the upper reaches of the Croton Reservoir near the Village of Katanoh. The drainage area contributing to the reservoir is approximately 316 square miles including controlled upland drainage from a large number of water supply reservoirs. Under normal hydrologic conditions, the volume of the impounded water is more a function of the inflow from the upland reservoirs than a function of the natural watershed contributing to the reservoir. The reservoir is the source of water supply for the downstream New Croton Reservoir.

For the purpose of this investigation, the dam spillway was analyzed with respect to its performance under severe flood discharges. Overtopping is not a significant concern since the structure performs as a weir. The peak flood stage is also of little concern since the dam's tailwater elevation will follow the peak discharge stage and this will not create additional head in the structure. The flood event rainfall was developed for the condition of the Probable Maximum Flood (PMF) for the watershed. The PMF is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration losses, and concentration of runoff at a specific location, that is considered reasonably possible for a particular drainage area.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Both Clark and Snyder parameters were evaluated. For the Clark Method, values of Tc = 17.5 and R = 7.5 were computed. For the Snyder Method, values of Tpr = 11.60 and Cp of 0.6 were used. Two unit hydrographs and two flood hydrographs were derived and compared with the intention of evaluating the more severe discharge from the flood hydrographs in the spillway analysis.

The Probable Maximum Flood (PMF) hydrograph was determined using Probable Maximum Precipitation rainfall data obtained in Hydrometeorlogical Report No. 51. An index rainfall of 24.1 inches for a 200 square mile area for a period of 24 hours was adopted for

the analysis. Both the PMF and 1/2 PMF (SPF) were evaluated. The 1/2 PMF was assumed to be approximately the Standard Project Flood (SPF) in utilizing the U.S. Army Corps of Engineers Hydrologic Engineering Center's Computer Program UHCOMP. The peak discharges for the Clark Method were 96,850 cfs for the 1/2 PMF (SPF) and 182,441 cfs for the PMF. The peak discharges for the Snyder Method were 96,300 cfs for the 1/2 PMF (SPF) and 184,000 cfs for the PMF.

The flood hydrographs derived using the Snyder parameters were routed over the structure using the U.S. Army Corps of Engineers Hydrologic Engineering Center's Program HEC-1 using the Modified Puls Method. An attempt was made to evaluate the upstream reservoirs' combined effect by lumping the stage-storage relationship in the analysis. Assuming 3 feet of head in each reservoir, this provides 17,500 acre feet of storage prior to any flood discharge at Muscoot. Additional runs were made considering only the Muscoot Reservoir's effect. It was determined in both types of analysis the reservoir's storage had an insignificant effect on the discharge over the structure. The depth of flow over the spillway was computed to be 10 feet for the 1/2 PMF (SPF) and 14 feet for the PMF.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations And Data Review

The dam was almost completely submerged at the time of the inspection; the headwaters were overtopping the weir type dam by a few inches. None of the dam structure could be examined.

b. Geology and Seismic Stability

There were no outcrops of rock seen in the vicinity of the south end of the dam. The northern end of the dam was not seen. According to the original State report concerned with the dam, presented prior to its construction, the north bank was gneiss and schist and the south bank was gneiss, etc. overlain by sand and gravel. The New York State Geologic Map (1970) shows both banks as well as the rock beneath the dam to be the Inwood Marble. Prucha (1959) shows on his map that the dam is sited partly on the Fordham Gneiss but mainly on the Inwood Marble. The trend of the steeply dipping foliation is easterly.

The marble is subject to solution and the gneiss often contains layers and lenses which weather in time thereby yielding rotted seams which would permit seepage. There is no evidence of this having occurred in the area of this dam.

Relative to the dam site, the closest known faults are approximately two miles distant. One fault lies northwest of the dam and trends northeast. The other is to the southwest with a northwest trend.

Information on some of the earthquakes for the area is tabulated below:

Date	Intensity-Modified Mercalli	Location Relative to Dam
1885	III	6 mi. NW
1937	II	6 mi. SW
1938 (2X)	III	4 mi. SSE
1938	II	6 mi. SE
1964 (2X)	II	4 mi. SSE
1964	V	4 mi. SSE
1967	V	6 mi. SW

The dam is located in an area designated Zone 1 on the Seismic Probability Map. Convention assumes no earthquake hazard for this designation.

c. Data Review and Stability Evaluation

Design drawings applicable to stability evaluations made available for this study are limited to dam cross-sections. Soil/rock properties and upstream/downstream water conditions utilized for the dams design are not known. As part of the present study, stability evaluations have been performed. Actual properties of the sites foundation soils and rock have not been determined; where data was lacking, simplifying assumptions felt to be conservative have been applied. The conditions for (1) an upstream water level at the damtop elevation, with ice acting, and a downstream water level at the downstream ground elevation; and (2) an upstream water level five feet below the top of the dam, with ice, and a downstream water level at the downstream ground elevation; and (3) an upstream water level at the damtop elevation, with ice acting, and a downstream water level 10 feet below the top of the dam, have been studied.

The analysis performed (See Appendix D) indicates marginal but satisfactory stability against overturning for combinations of upstream and downstream water levels and ice loadings. Generally, the computed factors of safety become lower as the difference between headwater and tailwater elevations increase.

Critical to the analysis and resulting indication of stability are the items of uplift water pressures acting on the base of the dam and relative permeabilities of the sites foundation soil and rock. The analysis uplift force was based on a full headwater hydrostatic pressure acting on the dams upstream corner and a full tailwater hydrostatic pressure acting at the dams downstream corner. Uplift pressures were assumed to vary linearly between the dams upstream and downstream corners, and act upon 100 percent of the dam base. For the combinations of upstream/downstream water levels studied, the uplift represents a condition of low factors of safety against overturning.

The assigned uplift force is conservative but may also be too great. The prediction of uplift acting on the base of a gravity dam supported on rock, without having information on the permeability/seepage properties of the foundation rock stratum, represents an engineering analysis area of great uncertainty. If the permeability of the rock stratum foundation is very high, the uplift pressure on the dams upstream corner could be less than a hydrostatic pressure computed on the basis of a full headwater elevation. The full headwater hydrostatic pressure is felt to be reasonable where the permeability of the rock foundation is very low compared to the permeability of soil in back of the dam (upstream side). If the rock is layered and jointed, the uplift computed assuming a linear variation of pressure and a resulting force acting only on an area equal to the dam base could be too low. However, if the rock is very sound and impermeable, seepage would be

very low, and uplift pressures of significance would require a long period of time to develop. Similarly, within the masonry itself (say near the base of the dam) hydrostatic pressures from permeating headwater potentially causing the same effect as uplift at the base of the dam could require a considerable period of time before reaching a significant magnitude. A conclusion drawn from these latter conditions is that the computed uplift utilized in this reports stability analysis may not exist at present and may only develop at some future time. Without a high uplift force acting, the factor of safety for stability against overturning and sliding would be at a level considered acceptable for design.

The dam has a proven record on stability for conditions where the difference between the upstream and downstream reservoir levels is not great. Desirably, future water level differences will not vary greatly from past practice. Any future requirement for significant lowering of the downstream reservoir while maintaining a full or near-full upstream reservoir or applying loading conditions not considered herein should be accompanied by proper engineering studies to assure adequate stability for the dam. For such studies, reliable data on uplift pressures will be important.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

On the basis of the Phase I visual examination and engineering analysis pertained herein, the Muscoot Dam appears to be adequate for normal operation. Since the dam was largely submerged (see overview photograph) a substantial portion of the inspection criteria (Ref. 1) could not be applied in the inspection and report effort. However, it is not recommended that the reservoir be lowered at this time to be inspected further.

From the stability analysis, it is generally recommended that future water level differences should not vary greatly from past practices. While the factor of safety in stability is marginal but satisfactory, future requirements for significant lowering of the downstream reservoir while maintaining a full or near full upstream reservoir or applying loading conditions not considered herein should be accompanied by proper engineering studies to assure adequate stability for the dam. For such studies, reliable field data on uplift pressures are important.

7.2 REMEDIAL MEASURES

No remedial measures relative to dam safety can be recommended at this time. Further stability evaluations are recommended prior to lowering the downstream reservoir levels significantly below the upstream level.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

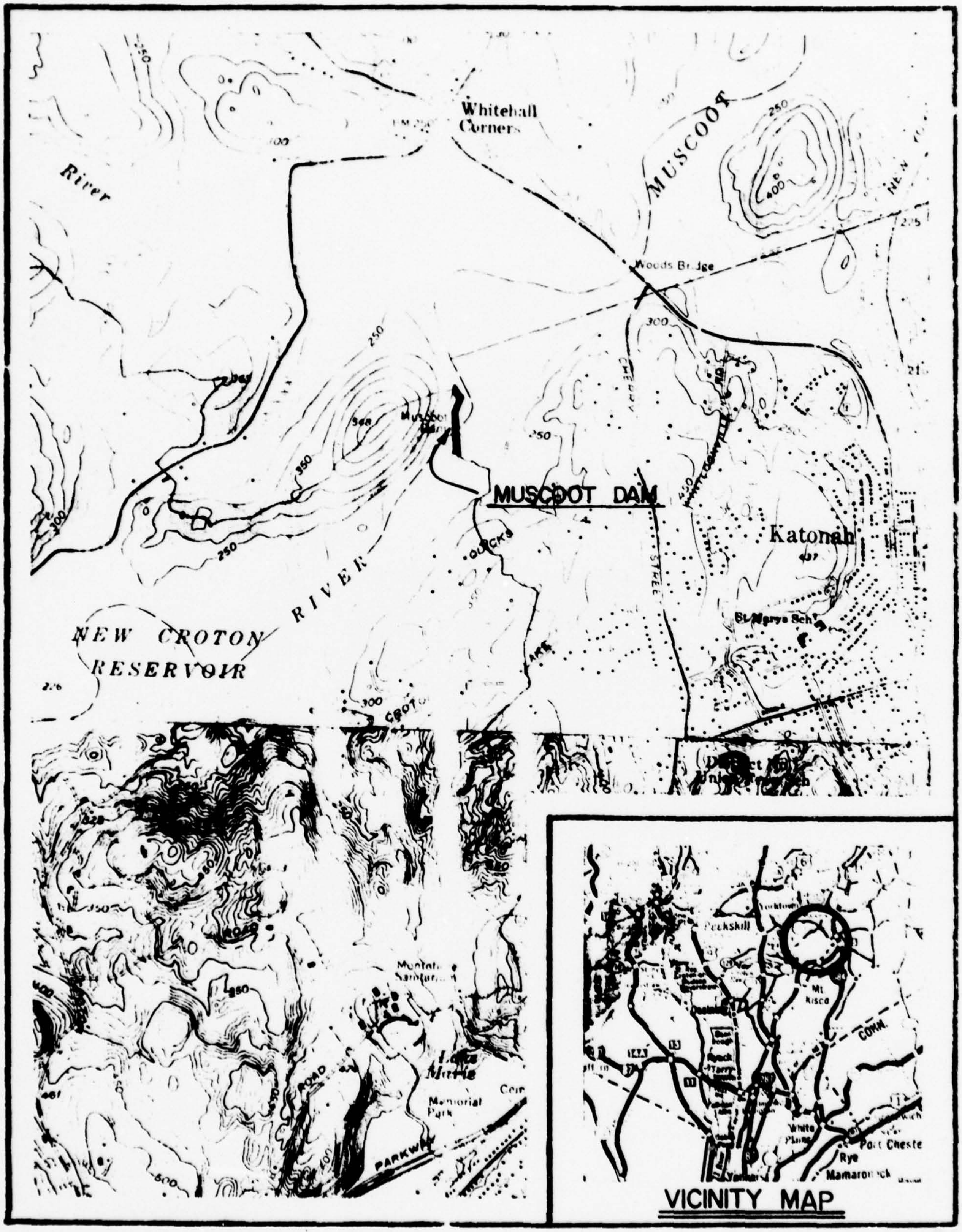
7.1 DAM ASSESSMENT

On the basis of the Phase I visual examination and engineering analysis pertained herein, the Muscoot Dam appears to be adequate for normal operation. Since the dam was largely submerged (see overview photograph) a substantial portion of the inspection criteria (Ref. 1) could not be applied in the inspection and report effort. However, it is not recommended that the reservoir be lowered at this time to be inspected further.

From the stability analysis, it is concluded and recommended that future water level differences should not vary greatly from past practices. Any future requirement for significant lowering of the downstream reservoir while maintaining a full or near full upstream reservoir should be accompanied by proper engineering studies to assure adequate stability for the dam. For such studies, reliable field data on uplift pressures will be important

7.2 REMEDIAL MEASURES

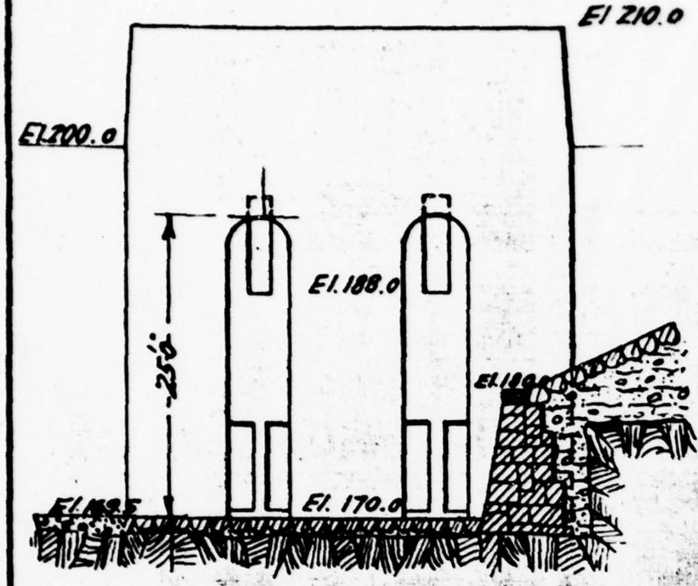
No remedial measures relative to dam safety can be recommended at this time. As mentioned above, pursuant to lowering the downstream reservoir while maintaining head in the upper further stability, further evaluations are recommended.



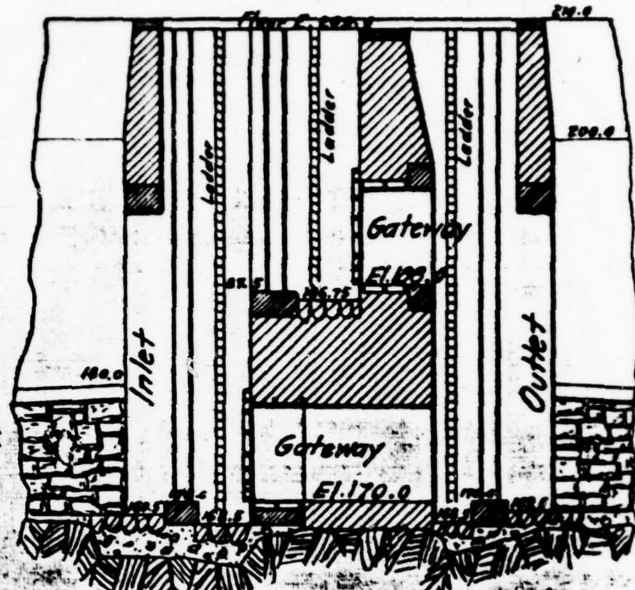
LOCATION PLAN

FIGURE 1

SHEET NO. 25
______ **SHEETS IN SET**

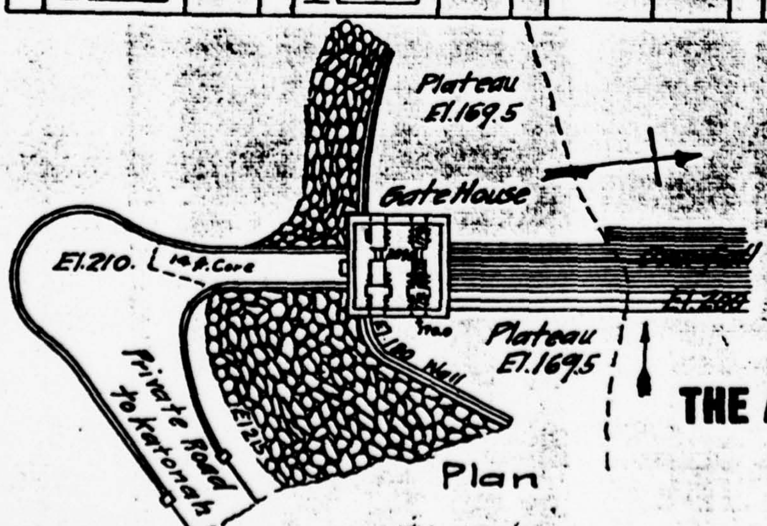


West Elevation

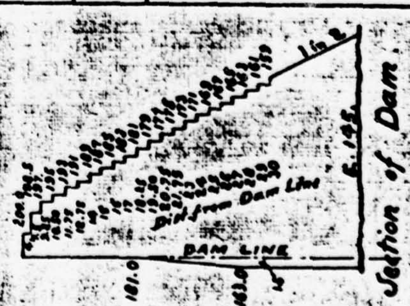


Section A-B

Inlets			Outlets			Gates			Stopcocks			Remarks
Number	Shape and Dimension	Elevation of Invert	Number	Shape and Dimension	Elevation of Invert	Number	Size	Elevation of Invert	Number	Diam.	Elevation of Invert	Abutm't N. of Spillway 75 ft. Spillway 950 Gate House 37 14 ft. core S. of G.H. 68 Total length of Dam 1130 ft.
2	25'6" × 5'5"	169.5	2	25'0" × 5'3"	169.5	2 4	2'×8' 2'×8'	188.0 170.0				Elevation of Spillway 200.0 Elevation of Flashboards 2020



Plan



CITY OF NEW YORK

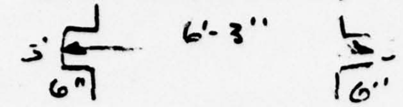
THE AQUEDUCT COMMISSIONERS

MUSCOOT DAM.

Drawn by A.S.F.
Traced by S.F.
Checked by W.E.K.

ACCESSION NO. ______

SLUICEWAY DIMENSIONS W 6'3" D 6", T = 5"



Stop Shutters 4. 4' x 6'-2" x 4¼"

FIGURE 3

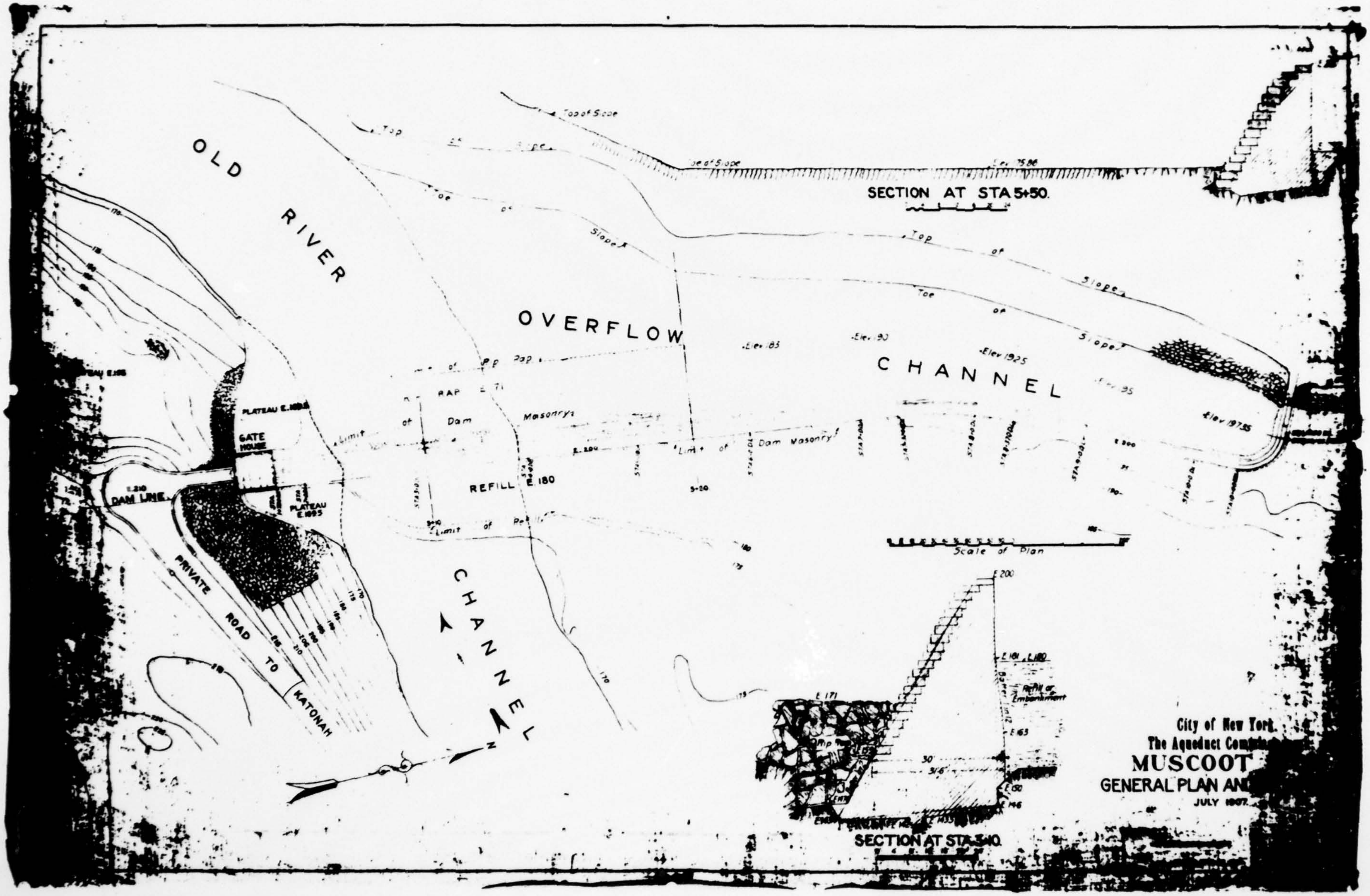

OLD RIVER
OVERFLOW CHANNEL
CHANNEL
SECTION AT STA 5+50
SECTION AT STA 5+10
Scale of Plan
GATE HOUSE
DAM LINE
REFILL E.180
PRIVATE ROAD TO KATONAH
City of New York
The Aqueduct Comm
MUSCOOT
GENERAL PLAN AN
JULY 1907

FIGURE 4

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam MUSCOOT DAM County WESCHESTER State NEW YORK ID # NY 33

Type of Dam MASONRY Hazard Category ---

Date(s) Inspection JULY 27, 1978 Weather CLOUDY Temperature 75°

Pool Elevation at Time of Inspection 200 M.S.L. Tailwater at Time of Inspection 196 ESTIMATED

Inspection Personnel:

N. F. DUNLEVY — DALE ENGINEERING COMPANY

F. W. BYSZEWSKI — DALE ENGINEERING COMPANY

D. F. McCARTHY — DALE ENGINEERING COMPANY

H. S. MUSKATT — DALE ENGINEERING COMPANY

JOHN BYRNES, KATONAH SECTION ENGR., N.Y.C. BOARD OF WATER SUPPLY

N. F. DUNLEVY Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	Reservoir was spilling over dam which has a spillway along it, total length.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	None observed.	
WATER PASSAGES	N/A	
FOUNDATION	Not observable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None observed.	Entire spillway was spilling.
STRUCTURAL CRACKING	None observed.	Entire spillway was spilling.
VERTICAL & HORIZONTAL ALIGNMENT	As viewed, no noticeable problems.	
MONOLITH JOINTS	[illegible] observed.	
CONSTRUCTION JOINTS	None observed.	
STAFF GAGE OF RECORDER	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	N/A	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N/A	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	N/A	
RIPRAP FAILURES	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	N/A	
STAFF GAGE AND RECORDER	N/A	
DRAINS	N/A	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR MASONRY	Entire dam acts as weir and was spilling. No noticeable problems.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	Discharges into Croton Dam Reservoir at downstream face of Muscoot.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	6 sluice gates control flows. Upper gate is open and is jambed open. The two lower gates were closed and operable.	
OUTLET STRUCTURE	Set plans. Same as intake.	
OUTLET CHANNEL	Empties into Croton Dam Reservoir.	
EMERGENCY GATE	None.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Croton Reservoir.	
SLOPES	N/A	
APPROXIMATE NO. OF HOMES AND POPULATION	None immediately downstream. Croton Reservoir is downstream. hazard lies below Croton.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	No significant slopes above reservoir observed.	
SEDIMENTATION	No problems observed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM Muscoot

ID # NY 33

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	See this report.
TYPICAL SECTIONS OF DAM	See this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See this report.
RAINFALL/RESERVOIR RECORDS	None.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	No data available.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	No data available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No data available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	See N.Y.C. Board of Water Supply.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See plans this report.
OPERATING EQUIPMENT PLANS & DETAILS	See data this report.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 82.13 sq. miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 196.40

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 196.40

ELEVATION MAXIMUM DESIGN POOL: 196.40

ELEVATION TOP DAM: 196.40

CREST:

a. Elevation 196.40
b. Type Weir crest
c. Width 4.00 feet
d. Length 1130.0 feet
e. Location Spillover Entire length of dam.
f. Number and Type of Gates None.

OUTLET WORKS:

a. Type Gated masonry conduits (see this report).
b. Location Gate house.
c. Entrance Inverts 170.00
d. Exit Inverts 170.00
e. Emergency Draindown Facilities None

HYDROMETEOROLOGICAL GATES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: ----

APPENDIX B

PREVIOUS INSPECTION REPORTS

STATE OF NEW YORK

State Engineer and Surveyor

Report of a Structure Impounding Water

To assist in carrying out the provisions of Section ... of the Conservation Law, being Chapter LXV of the Consolidated Laws of New York State, relating to safeguarding life and property and the erection, reconstruction, or maintenance of structures for impounding water, owners of such structures are requested to fill out as completely as possible this report form for each such dam or reservoir owned within the State of New York for which no plans or reports relative thereto are on file in this Department and to return this report form, together with prints or photographs explanatory thereof to this department.

The Croton ...

1. The structure is on the Croton River flowing into the Hudson River in the Town of Cortland County of Westchester County and New York

It is about three-quarter miles downstream from Wood's Bridge
(Give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream)

2. Is any part of the structure built upon or does its pond flood any State lands? No

3. The name and address of the owner is City of New York

4. The structure is used for maintaining a certain elevation of the water above the dam, for sanitary reasons

5. The material of the right bank, in the direction with the current, is rock (gneiss, schist, etc.) At the spillway crest elevation this material has a top slope of .... inches vertical to a foot horizontal on the center line of the structure, a vertical thickness at this elevation of .... feet, and the top surface extends for a vertical height of .... feet above the spillway crest.

6. The material of the left bank is gneiss, ... overlain by sand gravel, has a top slope of .... inches to a foot horizontal, a thickness of .... feet and a height of .... feet.

7. The natural material of the bed on which the structure rests is (~~clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.~~) a bastard granite, ... gneiss

8. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. rock is near the surface in most places and is overlain by sand and gravel. The rock is hard and impervious to water except in some seams & fissures.

B-1

9. If the bed is in layers, are the layers horizontal or inclined? .... If inclined what is the direction of the horizontal outcropping relative to the axis of the main structure and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping? ....

....

10. What is the thickness of the layers? ....

11. Are there any porous seams or fissures? ....

....

12. The watershed at the above structure and draining into the pond formed thereby is 315.73quare miles.

13. The pond area at the spillway crest elevation is 1135 acres and the pond impounds 657 million cubic feet of water.

14. The maximum known flow of the stream at the structure was .... cubic feet per second on ....
(Date)

15. Has the spillway capacity ever been exceeded by a high flow? ....

Can any possible flood flow from the pond otherwise than through the wastes noted under 17 and 18 of this report? .... If so, give the location, the length and the elevation relative to the spillway crest and the character and slopes of the ground of such possible wastes ....

....

....

16. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the above structure. Describe the location, the character and the use of buildings below the structure which might be damaged by any failure of the structure, of roads adjacent to or crossing the stream below the structure, giving the lowest elevation of the roadway above the streambed and giving the slope, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the structure ....

....

....

....

....

17. WASTES. The spillway of the above structure is 950 feet long in the clear; the waters are held at the right end by a rocky hill the top of which is .... feet above the spillway crest, and has a top width of .... feet; and at the left end by a gate house, the top of which is 10 feet above the spillway crest, and has a top width of 35 feet.

18. There is also for flood discharge a pipe .... inches inside diameter and the bottom is .... feet below the spillway crest; and ~~a~~ sluice gate outlet 2 feet wide in the clear by 3 feet high, and the bottom is 20.5 feet below the spillway crest.

19. APRON. Below the spillway there is ~~an~~ no apron built of .... feet wide and .... feet thick. The downstream side of the apron has a thickness of .... feet for a width of .... feet.

20. Has the structure any weaknesses which are liable to cause its failure in high flows? ....

No ....

21. SKETCHES. On the back of this report make a sketch to scale for each different cross-section of the above structure at the greatest depth; giving the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spillway at two feet below the crest), the elevation of the top in reference to the spillway crest, the length of the section, and the material of which the section is constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top width and top lengths from the upstream face of the spillway section; and outline the apron. Also sketch an elevation of each end of the structure with a cross section of the banks, giving the depth and width excavated into the banks.

22. WATER SUPPLY. The waters impounded by the above structure have ~~(not)~~ been used for a public water supply since ...1905... by ...the City of New York... ....

For the plans, profiles, etc. of the dam see Report of the Aqueduct Commissioners for 1895 to 1907, plates 91 to 93 inclusive.

The above information is correct to the best of my knowledge and belief.

Municipal Building, New York City
(Address of signer)

(Signature)

February - 1925
(Date)

Chief Engineer, Department of Water Supply

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APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 DESIGN BRIEF

PROJECT NAME NY DAM INSPECTION DATE 8.7.78

SUBJECT MUSCOUT DAM PROJECT NO. 8210

DRAWN BY NFO

NORTH ATLANTIC DIV WATER RESOURCES STUDY (FEB 72)

PLOT $T_c + R$'s

DA/S vs $T_c + R$

$S = 10$ FT/MI

$DA = 316$ MI^2

$DA/S = 316/10 = 31.6$

$T_c + R \doteq 25$ HRS

$R/(T_c + R) = 0.30$

$R = 7.5$

$T_c = 17.5$

DALE

DESIGN BRIEF

DESIGNED BY NFD　　DATE 8.7.78
CHECKED BY　　PAGE ____ OF ____
PROJECT NO. 2210　SHORT TITLE NY DAM INSPECTION
DESIGN SUBJECT MUSCOUT DAM　REF. DWGS.

ESTIMATE OF SNYDER'S PARAMETER

640 C_p =
C_p = 0.60 assumed
C_t = 1.00 assumed

$t_p = C_t (L \times L_{CA})^{0.3}$
= 2.0 (26 x 12.25)
= 11.34

$t_r = t_p / 5.5 = 11.34/5.5 = 2$

$t_{pr} = t_p + 0.25 (t_R - t_r) = 11.34 + 0.25 (3 - 2) = 11.60$

SUMMARY OF PARAMETERS

CLARK'S

~~BPR ——— Tc =~~
~~SCS (Cv Method) — Tc =~~
NORTH ATLANTIC DIV　Tc = 17.5

$R / (T_C + R) = 0.3$
R = 7.5

SNYDER'S

t_{pr} = 11.60
C_p = 0.60

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME NY DAM INSPECTION DATE 8-7-78

SUBJECT MUSCOUT DAM PROJECT NO. 2210

DRAWN BY JPG

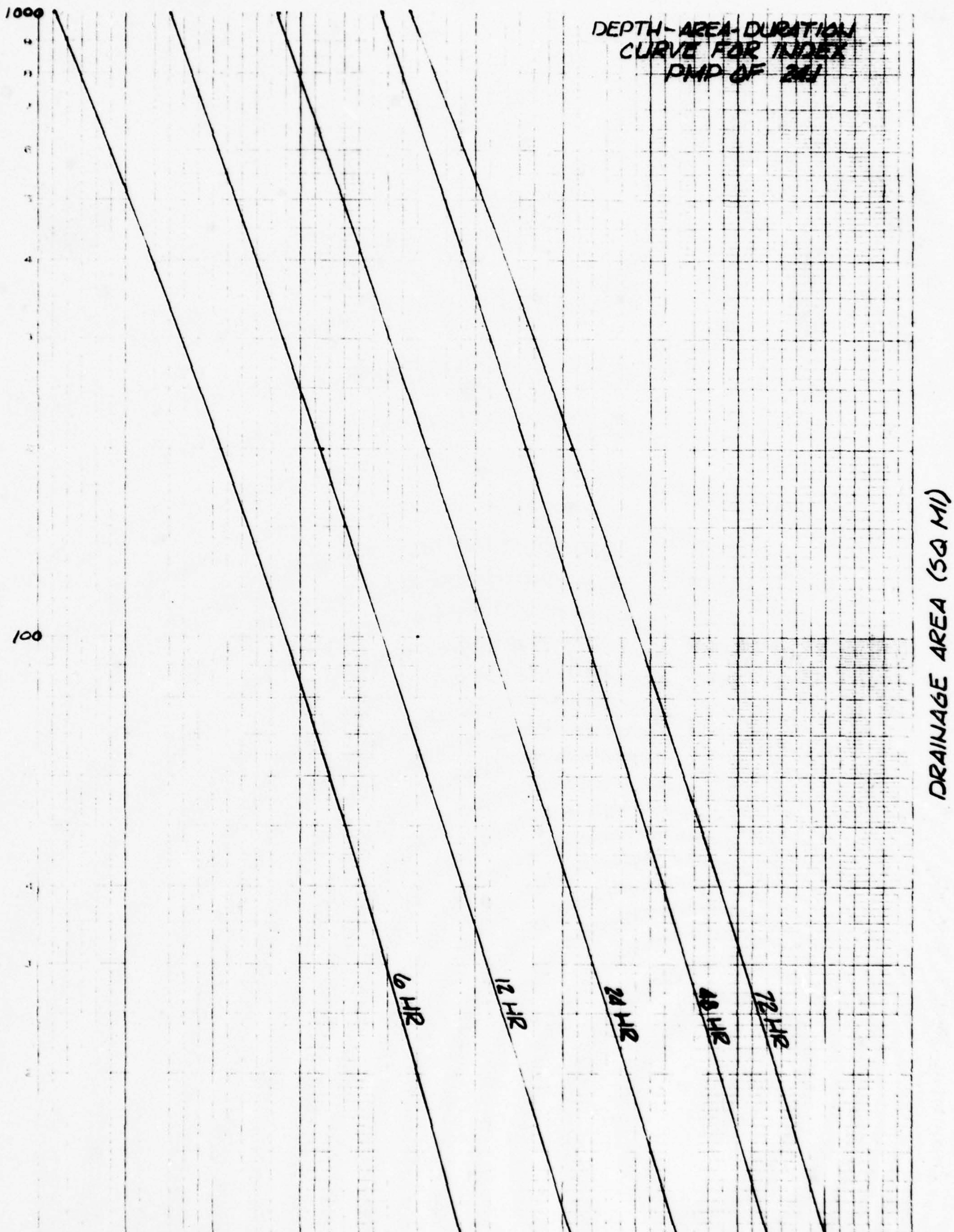
D-A-D RELATIONSHIP **

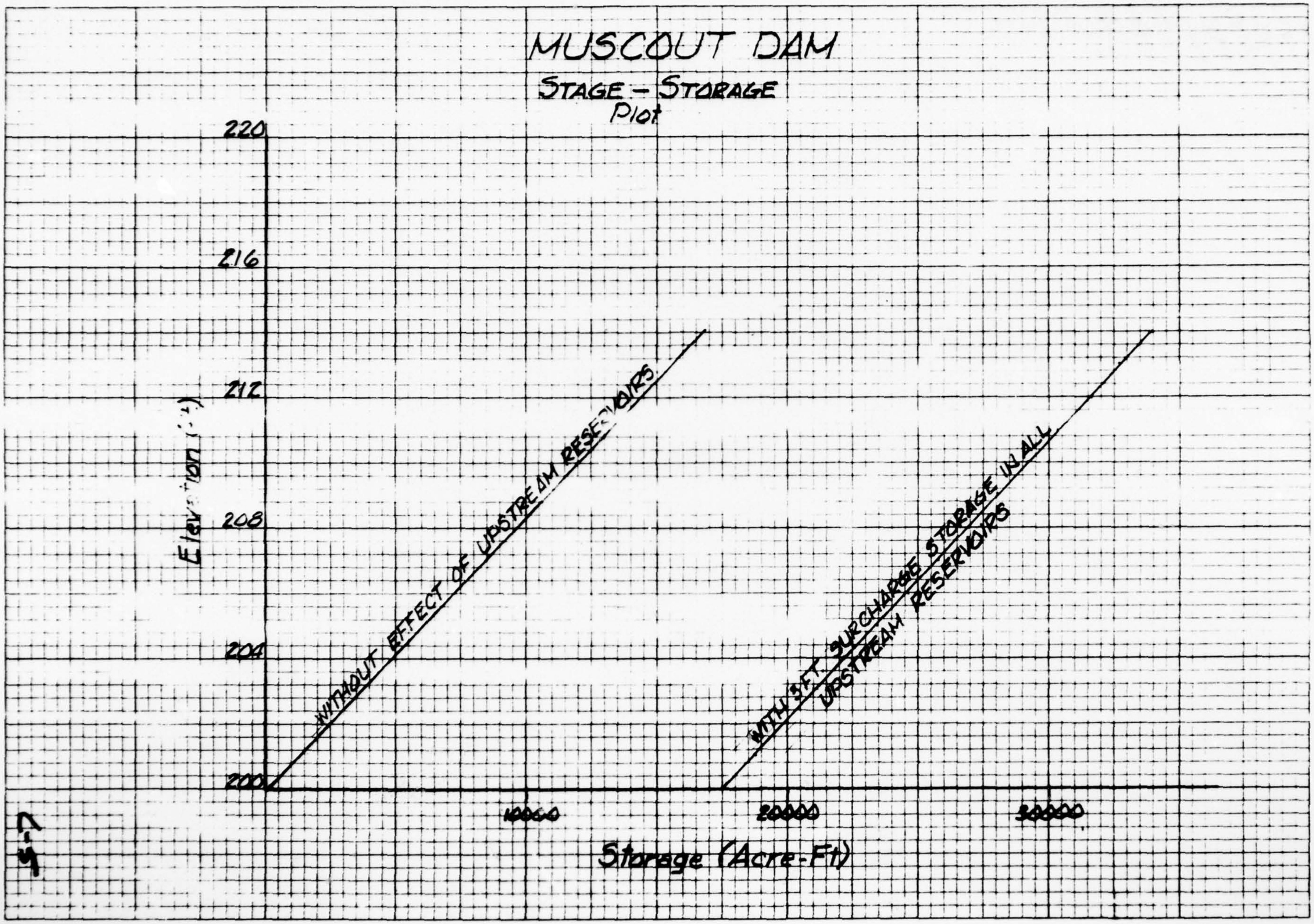
** PMP HYDROMETEOROLOGICAL REPORT NO 51

AREA	DURATION	DEPTH	% OF INDEX
10 MI²	6 HR	25.8	107
10 MI²	12 HR	29.5	122
10 MI²	24 HR	32.9	137
10 MI²	48 HR	36.5	151
10 MI²	72 HR	38.3	159
200 MI²	6 HR	17.[illegible]	73
200 MI²	12 HR	21.[illegible]	87
* 200 MI²	24 HR	24.	100
200 MI²	48 HR	27.8	115
200 MI²	72 HR	29.1	121
1000 MI²	6 HR	12.5	52
1000 MI²	12 HR	15.[illegible]	66
1000 MI²	24 HR	19.6	81
1000 MI²	48 HR	22.[illegible]	95
1000 MI²	72 HR	23.[illegible]	99

* PMP INDEX RAINFALL 24.1

DURATION	
6 HR	67.0
12 HR	81.0
24 HR	95.7
48 HR	109.5
72 HR	115.5


DEPTH-AREA-DURATION
CURVE FOR INDEX
PMP OF 24
1000
100
10
60
72
84
96
108
120
132
146
158
% OF 24HR-200 MI
DRAINAGE AREA (SQ MI)
6 HR
12 HR
24 HR
48 HR
72 HR


MUSCOUT DAM
STAGE – STORAGE
Plot
220
216
212
208
204
200
Elevation
WITHOUT EFFECT OF UPSTREAM RESERVOIRS
WITH 3 FT. SURCHARGE STORAGE IN ALL UPSTREAM RESERVOIRS
10000
20000
30000
Storage (Acre-Ft)

DALE

DESIGN BRIEF

DESIGNED BY NFD

DATE 8.11.78

CHECKED BY

PAGE C-6 OF

PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTION

DESIGN SUBJECT UHCOMP COMPUTER RUNS SUMMARY REF. DWGS.

SPF	CLARK	PARAMETERS	96,850	CFS
	SNYDER	PARAMETERS	96,300	CFS
PMF	CLARK	PARAMETERS	182,441	CFS
	SNYDER	PARAMETERS	184,000	CFS

```
UNIT GRAPH AND HYDROGRAPH COMP JULY 1966 (REVISED AUGUST 1974)
HYDROLOGIC ENGINEERING CENTER (HEC)
DAVIS,CA


--- OPERATIONS AVAILABLE ---

TIME INT = SET TIME INTERVAL OF ALL COMPUTATIONS
UNIT H   = COMPUTE UH BY INPUT, CLARK, OR SNYDER
RAIN     = INPUT RAIN AND LOSS RATE DATA
RUNOFF   = INPUT BASEFLOW, COMPUTE & PRINT HYDROGRAPH
PNT      = PRINT UNIT HYDROGRAPH ONLY
STOP     = STOP EXECUTION OF PROGRAM

USER MUST SELECT OPERATION DESIRED
MAY RETURN TO ANY OPERATION


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  180.


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =    15.0
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )        2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=      0
ENTER CLARKS TC AND R (HRS) =       17.50       7.50

       TP        CP       TC        R

    13.60    0.759    17.50     7.50
```

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3 RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )        2
ENTER SPS INDEX RAINFALL (IN) = 12.00
ENTER TRSPC AND TRSDA (SQMI) =              1.00    315.00
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00        0.10


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   MUSCOOT DAM SPF
ENTER STRTQ,QRCSN,AND RTIOR =       630.00  630.00     1.00
```

HR	MIN	RAIN	LOSS	EXCESS	UNIT HG	RECSN	FLOW
3	0	0.01	0.01	0.00	1133.	630.	630.
6	0	0.01	0.01	0.00	3961.	630.	630.
9	0	0.03	0.03	0.00	7391.	630.	630.
12	0	0.03	0.03	0.00	10198.	630.	630.
15	0	0.10	0.10	0.00	11341.	630.	630.
18	0	0.20	0.20	0.00	10373.	630.	630.
21	0	0.02	0.02	0.00	7777.	630.	630.
24	0	0.02	0.02	0.00	5185.	630.	630.
27	0	0.05	0.05	0.00	3457.	630.	630.
30	0	0.05	0.05	0.00	2305.	630.	630.
33	0	0.13	0.13	0.00	1537.	630.	630.
36	0	0.13	0.13	0.00	1025.	630.	630.
39	0	0.45	0.37	0.08	683	630.	721.
42	0	0.91	0.30	0.61	45	630.	1638.
45	0	0.08	0.08	0.00	30	0.	3637.
48	0	0.08	0.08	0.00	20	0.	5955.
51	0	0.30	0.30	0.00	135	30.	7758.
54	0	0.30	0.30	0.00	90	30.	8378.
57	0	0.79	0.30	0.49		30.	8135.
60	0	0.79	0.30	0.49		630.	8285.
63	0	2.77	0.30	2.47		630.	12430.
66	0	5.63	0.30	5.33		630.	27363.
69	0	0.49	0.30	0.19		630.	52294.
72	0	0.49	0.30	0.19		630.	77842.
75	0	0.02	0.02	0.00		630.	94727.
78	0	0.02	0.02	0.00		630.	96843.
81	0	0.05	0.05	0.00		630.	83758.
84	0	0.05	0.05	0.00		630.	62042.
87	0	0.17	0.17	0.00		630.	42271.
90	0	0.35	0.30	0.05		630.	28613.
93	0	0.03	0.03	0.00		630.	19442.
96	0	0.03	0.03	0.00		630.	13374.
99	0					630.	9391.

102	0					630.	6699.
105	0					630.	4818.
108	0					630.	3467.
111	0					630.	2493.
114	0					630.	1844.
117	0					630.	1291.
120	0					630.	750.
123	0					630.	698.
126	0					630.	664.
129	0					630.	653.
132	0					630.	645.
135	0					630.	640.
138	0					630.	637.
141	0					630.	635.
144	0					630.	630.
147	0					630.	630.
TOTAL		14.58	4.68	9.90	67553.	30870.	699647.

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  180.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =    315.00
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )          3
ENTER SNYDERS CP AND TP (HRS) =             0.62      11.60
ENTER INITIAL EST. CLARKS TC K (HRS) (0=DEFAULT)=  0.00       0.00

       TP        CP       TC        R

     9.82     0.591    13.71     8.77
    11.41     0.660    13.94     9.26
    11.59     0.642    13.94     9.52
    11.63     0.634    13.94     9.65
    11.64     0.629    13.94     9.65

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =         0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )         2
ENTER SPS INDEX RAINFALL (IN) = 12.00
ENTER TRSPC AND TRSDA (SQMI) =              1.00     315.00
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00       0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   MUSCOOT SPF
ENTER STRTQ,QRCSN,AND RTIOR =       630.00  630.00      1.00
```

HR	MIN	RAIN	LOSS	EXCESS	UNI HG	RECSN	FLOW
3	0	0.01	0.01	0.00	[illegible]	630.	630.
6	0	0.01	0.01	0.00	[illegible]	630.	630.
9	0	0.03	0.03	0.00	8453.	630.	630.
12	0	0.03	0.03	0.00	10983.	630.	630.
15	0	0.10	0.10	0.00	10747.	630.	630.
18	0	0.20	0.20	0.00	8525.	630.	630.
21	0	0.02	0.02	0.00	6231.	630.	630.
24	0	0.02	0.02	0.00	4555.	630.	630.
27	0	0.05	0.05	0.00	3329.	630.	630.
30	0	0.05	0.05	0.00	[illegible]	630.	630.
33	0	0.13	0.13	0.00	[illegible]	630.	630.
36	0	0.13	0.13	0.00	[illegible]	630.	630.
39	0	0.45	0.37	0.08	[illegible]	630.	[illegible]
42	0	0.91	0.30	0.61	[illegible]	630.	1781.
45	0	0.08	0.08	0.00	[illegible]	630.	4099.
48	0	0.08	0.08	0.00	[illegible]	630.	6665.
51	0	0.30	0.30	0.00	[illegible]	630.	[illegible]
54	0	0.30	0.30	0.00	[illegible]	630.	7868.
57	0	0.79	0.30	0.49	[illegible]	630.	6959.
60	0	0.79	0.30	0.49	[illegible]	630.	7669.
63	0	2.77	0.30	2.47		630.	13237.
66	0	5.63	0.30	5.33		630.	30545.
69	0	0.49	0.30	0.19		630.	58433.
72	0	0.49	0.30	0.19		630.	84560.
75	0	0.02	0.02	0.00		630.	96289.
78	0	0.02	0.02	0.00		630.	68582.
81	0	0.05	0.05	0.00		630.	69916.
84	0	0.05	0.05	0.00		630.	51917.
87	0	0.17	0.17	0.00		630.	38244.

90	0	0.35	0.30	0.05		630.	28188.
93	0	0.03	0.03	0.00		630.	20956.
96	0	0.03	0.03	0.00		630.	15743.
99	0					630.	11911.
102	0					630.	8965.
105	0					630.	6757.
108	0					630.	5110.
111	0					630.	3905.
114	0					630.	3025.
117	0					630.	2344.
120	0					630.	1846.
123	0					630.	1327.
126	0					630.	725.
129	0					630.	685.
132	0					630.	655.
135	0					630.	649.
138	0					630.	644.
141	0					630.	640.
144	0					630.	637.
147	0					630.	635.
150	0					630.	630.
153	0					630.	630.
TOTAL		14.58	4.68	9.90	67447.	32130.	699851.

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=  180.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =    315.00
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )        2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=      0
ENTER CLARKS TC AND R (HRS) =        17.50       7.50

       TP        CP       TC        R

   13.60   0.759   17.50     7.50

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )       3
ENTER PMS INDEX RAINFALL (IN) = 24.10
ENTER R6,R12,R24,R48,R72,R96 =       6[illegible].00   81.00    95.70  109.70  115.50    0.00
ENTER TRSPC AND TRSDA (SQMI) =           0.00    315.00
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)         1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =      1.00       0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   MUSCOOT PMF
ENTER STRTQ,QRCSN,AND RTIOR =      630.00  630.00     1.00

 HR MIN   RAIN  LOSS EXCESS   UNIT HG    RECSN     FLOW
  3   0   0.09  0.09  0.00     1133.      630.      630.
  6   0   0.09  0.09  0.00     3961.      630.      630.
  9   0   0.22  0.22  0.00     7391.      630.      630.
 12   0   0.22  0.22  0.00    1019[illegible].      630.      630.
 15   0   0.69  0.51  0.18    11341.      630.      834.
 18   0   1.41  0.30  1.11    1037[illegible].      630      2601.
 21   0   0.14  0.14  0.00     7777.      630      6357.
 24   0   0.14  0.14  0.00     518[illegible].      630     10670.
 27   0   0.63  0.30  0.33     345[illegible].      630.    14365.
 30   0   0.63  0.30  0.33     230[illegible].      630.    16766.
 33   0   1.50  0.30  1.20     1537.      630.    18650.
 36   0   1.50  0.30  1.20     1025.      630.    22113.
 39   0   4.75  0.30  4.45      683.      630.    32780.
 42   0   9.64  0.30  9.34      456.      630.    61361.
 45   0   0.95  0.30  0.65      304.      630.   105920.
 48   0   0.95  0.30  0.65      203.      630.   150581.
 51   0   0.04  0.04  0.00      135.      630.   179616.
 54   0   0.04  0.04  0.00       90.      630.   182441.
 57   0   0.09  0.09  0.00                630.   158323.
 60   0   0.09  0.09  0.00                630.   118592.
```

63	0	0.29	0.29	0.00		630.	81663.
66	0	0.56	0.56	0.28		630.	55533.
69	0	0.06	0.06	0.00		630.	38122.
72	0	0.06	0.06	0.00		630.	26891.
75	0					630.	19616.
78	0					630.	14562.
81	0					630.	10689.
84	0					630.	7560.
87	0					630.	5181.
90	0					630.	3594.
93	0					630.	2340.
96	0					630.	1207.
99	0					630.	976.
102	0					630.	821.
105	0					630.	758.
108	0					630.	715.
111	0					630.	687.
114	0					630.	668.
117	0					630.	655.
120	0					630.	630.
123	0					630.	630.
TOTAL		24.30	5.08	19.72	67553.	25830.	1357981.

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)       1
ENTER TIME INTERVAL(MIN)=  180.


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)       2
ENTER DRAINAGE AREA (SQMI) =    315.00
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )       3
ENTER SNYDERS CP AND TP (HRS) =          0.62      11.20
ENTER INITIAL EST. CLARKS TC R (HRS) (0=DEFAULT)=  0.00       0.00

       TP        CP        TC        R

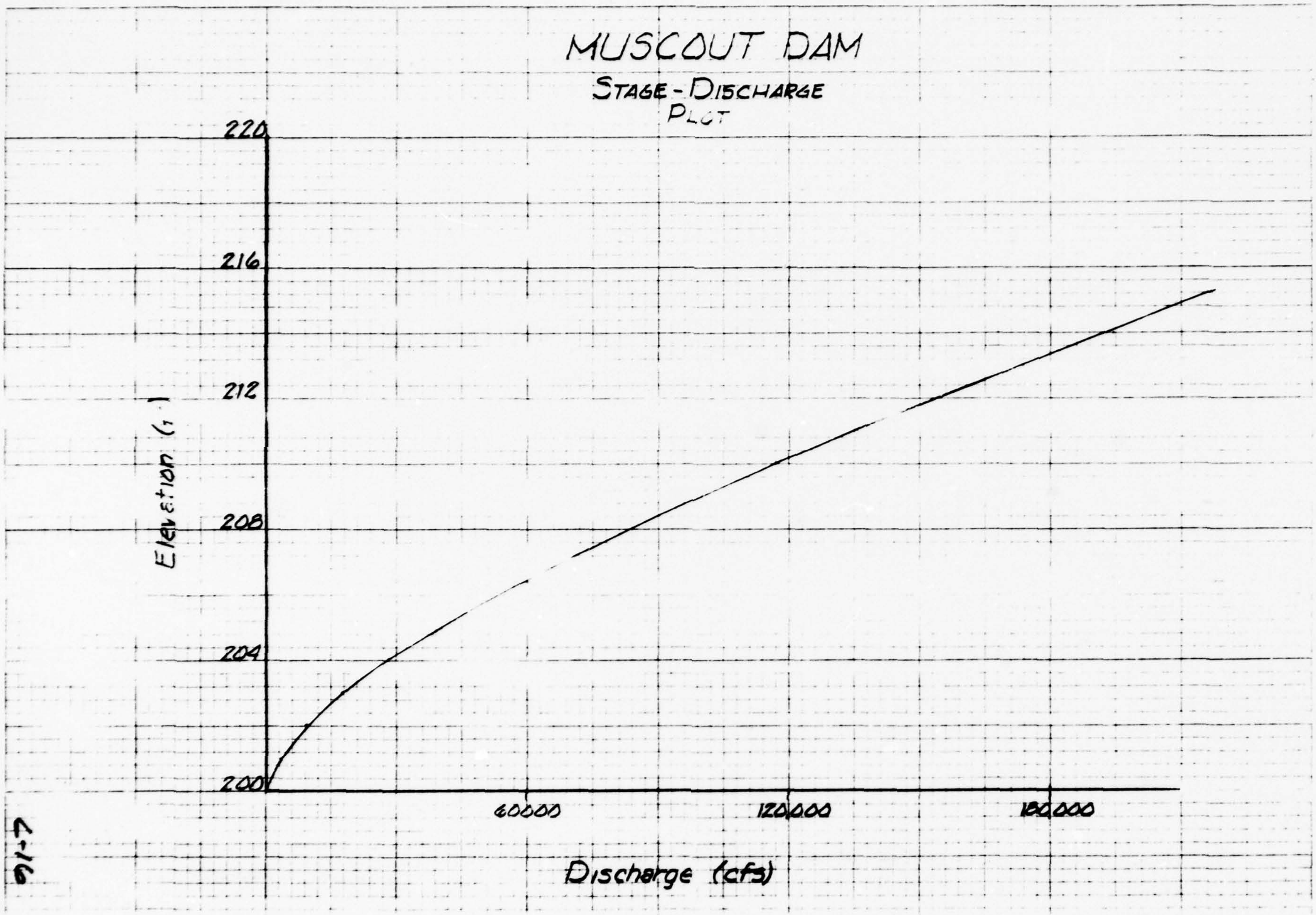
     9.35     0.575     13.41      8.24
    11.14     0.677     13.41      8.93
    11.28     0.656     13.41      9.37
    11.35     0.642     13.23      9.63
    11.30     0.635     13.23      9.78
    11.32     0.630     13.08      9.78
    11.25     0.630     13.08      9.78


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)       3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )         3
ENTER PMS INDEX RAINFALL (IN) = 24.10
ENTER R6,R12,R24,R48,R72,R96 =       67.00    81.00    95.70   109.70   115.50     0.00
ENTER TRSPC AND TRSDA (SQMI) =               0.00     315.00
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00       0.10


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)       4
ENTER A TITLE PLEASE -   MUSCOOT R
ENTER STRTQ,QRCSN,AND RTIOR =       630.00   630.00     1.00

 HR MIN   RAIN   LOSS EXCESS   UNIT HG     RECSN      FLOW
  3   0   0.09   0.09   0.00     1398.      630.       630.
  6   0   0.09   0.09   0.00     4983.      630.       630.
  9   0   0.22   0.22   0.00     9045.      630.       630.
 12   0   0.22   0.22   0.00    11387.      630.       630.
 15   0   0.69   0.51   0.18    10579.      630.       882.
 18   0   1.41   0.30   1.11     8069.      630.      3079.
 21   0   0.14   0.14   0.00     5923.      630.      7789.
 24   0   0.14   0.14   0.00     4348.      630.     12719.
 27   0   0.63   0.30   0.33     3191.      630.     15635.
 30   0   0.63   0.30   0.33     2343.      630.     15931.
 33   0   1.50   0.30   1.20     1720.      630.     16960.
 36   0   1.50   0.30   1.20     1262.      630.     22387.
 39   0   4.75   0.30   4.45      927.      630.     36335.
 42   0   9.64   0.30   9.34      680.      630.     70500.
 45   0   0.95   0.30   0.65      500.      630.    122211.
 48   0   0.95   0.30   0.65      367.      630.    167828.
 51   0   0.04   0.04   0.00      269.      630.    184024.
 54   0   0.04   0.04   0.00      198.      630.    163933.
 57   0   0.09   0.09   0.00      145.      630.    127866.
```

60	0	0.09	0.09	0.00	107.	630.	95687.
63	0	0.29	0.29	0.00		630.	70588.
66	0	0.58	0.30	0.28		630.	52374.
69	0	0.06	0.06	0.00		630.	39721.
72	0	0.06	0.06	0.00		630.	30834.
75	0					630.	24118.
78	0					630.	18408.
81	0					630.	13767.
84	0					630.	10275.
87	0					630.	7686.
90	0					630.	5786.
93	0					630.	4322.
96	0					630.	3248.
99	0					630.	2204.
102	0					630.	1053.
105	0					630.	890.
108	0					630.	770.
111	0					630.	733.
114	0					630.	705.
117	0					630.	685.
120	0					630.	671.
123	0					630.	660.
126	0					630.	630.
129	0					630.	630.
TOTAL		24.80	5.08	19.72	6744	27090.	157018.


MUSCOUT DAM
STAGE-DISCHARGE
PLOT
220
216
212
208
204
200
60000
120,000
180,000
Discharge (cfs)

```
00100 A MUSCOOT DAM
0110 A RESERVOIR ROUTING OVER STRUCTURE OF [illegible]F
0120 A INCLUDES MUSCOOT RESERVOIR EFFECT PL[illegible] EST. STORAGE OF UPSTREAM IMPOUNDMENTS
0130 B     37      3
0140 1      3
0150 K      0
00160 M    -1              315
0170 N    630    834   2601   6357  1067[illegible] 14365  16766  18650  22113  32780
0180 N  61361 105920 150581 179616 1824[illegible] 158323 118592 81663  55533  38122
0190 N  26891  19616  14562  10689  756[illegible]  5181   3594   2340   1207    976
0200 N    821    758    715    687   66[illegible]   655    630
0210 K      1
0220 Y                               1
0230 1      1                                              -1
0240 2  17500  18766  19932  21098  2226[illegible]  23530  26928  29260  31592  33924
0250 3      0   3040   9140  17770  2812[illegible]  54450  83834 117160 154010 194080
0260 K     99
0270 A
0280 A
0290 A
```

```
00100 A MUSCOOT DAM
0110 A RESERVOIR ROUTING OVER STRUCT[illegible]RE OF [illegible]F
0120 A INCLUDES MUSCOOT RESERVOIR EFFECT [illegible] EST. [illegible]RAGE [illegible] UP[illegible]EAM IMP[illegible]UNDMENTS
0130 B     37      3
0140 1      3
0150 K      0
00160 M    -1              315
0170 N    630    721   1638   3637   5[illegible]55   7758   8378   8135   8285  12430
0180 N  27363  52294  77842  94727  96843  83758  62042  42271  28613  19442
0190 N  13374   9391   6699   4818   3467   2493   1844   1291    750    698
0200 N    664    653    645    640    637    635    630
0210 K      1
0220 Y                               1
0230 1      1                                              -1
0240 2  17500  18766  19932  21098  22264  23530  26928  29260  31592  33924
0250 3      0   3040   9140  17770  28120  54450  83834 117160 154010 194080
0260 K     99
0270 A
00280 A
0290 A
```

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****************************
EC-1 VERSION DATED JAN 1973
PDATED AUG 74
HANGE NO. 01
***************************

****************************
EC-1 VERSION DATED JAN 1973
PDATED AUG 74
HANGE NO. 01
***************************
                    MUSCOOT DAM
                    RESERVOIR ROUTING OVER STRUCTURE OF SPF
                    INCLUDES MUSCOOT RESERVOIR

                                  JOB SPECIFICATION
                  NQ    NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
                  37      3     0     0     0     0     0     0     0     0
                                 JOPER    NWT
                                     3      0


     **********     **********     ***  *****     *********     **********

                         SUB-AREA RUNOFF COMPUTATION
                  ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                      0       0       0       0       0       0       0

                               HYDROGRAPH DATA
         IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
            -1      0  315.00    0.0     0.0     0.0     0.0       0       0       0

                               INPUT HYDROGRAPH
   630.     721.    1630.    3637.    5955.    7758.    8378.    8135.    8285.   12430.
 27363.   52294.   77842.   94727.   96843.   83758.   62042.   42271.   28613.   19442.
 13374.    9391.    6699.    4818.    3467.    2493.    1844.    1291.     750.     698.
   664.     653.     645.     640.     637.     635.     630.

                       PEAK   6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
              CFS    96843.   95785.    67299.    28411.       692091.
           INCHES               2.83      7.95     10.07         10.22
            AC-FT             47521.  1[illegible]554.   169143.       171681.


     **********     **********     **********     *********     **********

                               HYDROGRAPH ROUTING
                  ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                      0       1       0       0       0       0       0
                                 ROUTING DATA
                        QLOSS   CLOSS     AVG    IRES   ISAME
                          0.0     0.0     0.0       1       0

                  NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA
                      1       0       0     0.0     0.0     0.0     -1.
```

STORAGE0	0.	1266.	2432.	3598.	4764.	6030.	9428.	10760.	14092.	16420.
OUTFLOW0	0.	3040.	9140.	17770.	33120.	54450.	83834.	117160.	154010.	194000.

TIME	EOP STOR	AVG IN	EOP OUT
1	262.	630.	630.
2	271.	676.	651.
3	372.	1180.	893.
4	705.	2638.	1694.
5	1291.	4796.	3172.
6	1845.	6857.	6071.
7	2146.	8068.	7642.
8	2238.	8257.	8126.
9	2251.	8210.	8192.
10	2556.	10358.	10059.
11	3808.	19897.	19635.
12	5602.	39829.	45551.
13	7626.	65068.	68255.
14	9608.	86285.	88331.
15	10058.	95785.	99604.
16	9496.	90301.	85533.
17	8051.	72900.	71924.
18	5830.	52157.	50299.
19	4801.	35442.	28889.
20	4253.	24028.	23585.
21	3388.	16408.	16213.
22	2763.	11383.	11590.
23	2284.	8045.	8365.
24	1892.	5759.	6314.
25	1565.	4143.	4606.
26	1321.	2980.	3327.
27	1114.	2169.	2676.
28	903.	1568.	2167.
29	683.	921.	1641.
30	508.	724.	1220.
31	405.	681.	973.
32	345.	659.	829.
33	311.	649.	746.
34	291.	643.	699.
35	279.	639.	671.
36	273.	636.	655.
37	268.	633.	645.
SUM			692073.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	99604.	93968.	67298.	28339.	692073.
INCHES		2.77	7.95	10.04	10.22
AC-FT		46620.	133553.	168713.	171677.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	0	96843.	95785.	67299.	28411.	315.00
ROUTED TO	0	99604.	93968.	67298.	28339.	315.00

[illegible]

HANGE NO. 01

****

MUSCOOT DAM

RESERVOIR ROUTING OVER STRUCTURE OF SPF

INCLUDES MUSCOOT RESERVOIR EFFECT PLUS EST. STORAGE OF UPSTREAM IMPOUNDMENTS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
37	3	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	315.00	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

630.	721.	1638.	3637.	5955.	7758.	8378.	8135.	8285.	12430.
27363.	52294.	77842.	94727.	96843.	83758.	62042.	42271.	28613.	19442.
13374.	9391.	6699.	4818.	3467.	2493.	1844.	1291.	750.	698.
664.	653.	645.	640.	637.	635.	630.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	96843.	95785.	67299.	28411.	692091.
INCHES		2.83	7.95	10.07	10.22
AC-FT		47521.	133554.	169143.	171681.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	17500.	18766.	19932.	21098.	22264.	23530.	26928.	29260.	31592.	33924.
OUTFLOW=	0.	3040.	9140.	17770.	28120.	54450.	83834.	117160.	154010.	194000.

TIME	EOP STOR	AVG IN	EOP OUT
1	17762.	630.	630.
2	17771.	676.	651.
3	17872.	1180.	893.
4	18205.	2638.	1694.
5	18791.	4796.	3172.
6	19345.	6857.	6071.
7	19646.	8068.	7642.
8	19738	8257.	8126.
9	1975[illegible]	821[illegible].	8192.

C-20

10	20056.	10358.	10059.
11	21308.	19897.	19635.
12	23102.	39829.	45550.
13	25126.	65068.	68255.
14	27194.	86285.	87635.
15	27923.	95785.	98054.
16	27229.	90301.	88142.
17	25507.	72900.	71549.
18	23331.	52157.	50317.
19	22301.	35442.	28881.
20	21753.	24028.	23588.
21	20888.	16408.	16213.
22	20263.	11383.	11590.
23	19784.	8045.	8365.
24	19392.	5759.	6314.
25	19065.	4143.	4605.
26	18821.	2980.	3327.
27	18614.	2169.	2676.
28	18403.	1568.	2167.
29	18183.	1021.	1641.
30	18008.	724.	1220.
31	17905.	681.	973.
32	17845.	659.	829.
33	17811.	649.	746.
34	17791.	643.	699.
35	17779.	639.	671.
36	17773.	636.	655.
37	17768.	633.	645.
SUM			692072.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	98054.	93098.	67298.	28339.	692072.
INCHES		2.75	7.95	10.04	10.22
AC-FT		46178.	133553.	168713.	171677.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	0	96843.	95785.	67299.	28411.	315.00
ROUTED TO	0	98054.	93098.	67298.	28339.	315.00

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EC-1 VERSION DATED JAN 1973
PDATED AUG 74
HANGE NO. 01
****

MUSCOOT DAM
RESERVOIR ROUTING OVER STRUCTURE OF PMF
INCLUDES MUSCOOT RESERVOIR EFFECT PLUS EST. STORAGE OF UPSTREAM IMPOUNDMENTS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
37	3	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	315.00	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

630.	834.	2601.	6357.	10670.	14365.	16766.	18650.	22113.	32780.
61361.	105920.	150581.	179616.	182441.	158323.	118592.	81663.	55533.	38122.
26891.	19616.	14562.	10689.	7560.	5181.	3594.	2340.	1207.	976.
821.	758.	715.	687.	68.	655.	630.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	182441.	181029.	129812.	55914.	1355468.
INCHES		5.35	15.33	19.81	20.01
AC-FT		89813.	257611.	332885.	336240.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	17500.	18766.	19932.	21098.	22264.	23530.	26928.	29260.	31592.	33924.
OUTFLOW=	0.	3040.	9140.	17770.	28120.	54450.	83834.	117160.	154010.	194000.

TIME	EOP STOR	AVG IN	EOP OUT
1	1776[illegible].	630.	630.
2	17782.	732.	677.
3	17981.	1718.	1154.
4	18616.	4479.	2680.
5	19525.	8514.	7012.
6	202[illegible].	12518.	11820.
7	2077[illegible]	15566.	15404.
8	2107[illegible]	17708.	17609.

9	21[illegible]05.	20382.	20499.
10	222[illegible]6.	27447.	27779.
11	236[illegible]3.	47071.	55169.
12	26[illegible]97.	83641.	84817.
13	307[illegible]9.	128251.	141170.
14	32719.	165099.	173379.
15	33[illegible]25.	181029.	183790.
16	32263.	170382.	165541.
17	30033.	138458.	129367.
18	27469.	100128.	91566.
19	24903.	68598.	66326.
20	22974.	46828.	42891.
21	22248.	32507.	27979.
22	21690.	23254.	23028.
23	20979.	17089.	16889.
24	20428.	12626.	12809.
25	19951.	9125.	9283.
26	19516.	6371.	6966.
27	19129.	4388.	4937.
28	1883[illegible].	2967.	3387.
29	1854[illegible].	1774.	2502.
30	1827[illegible].	1092.	1855.
31	18090.	899.	1416.
32	17970.	790.	1129.
33	17895.	737.	949.
34	17848.	701.	835.
35	17818.	678.	763.
36	17798.	662.	716.
37	17784.	643.	682.
SUM			1355395.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	183790.	178585.	129495.	55809.	1355395.
INCHES		5.27	15.30	19.78	20.01
AC-FT		88600.	256981.	332256.	336222.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

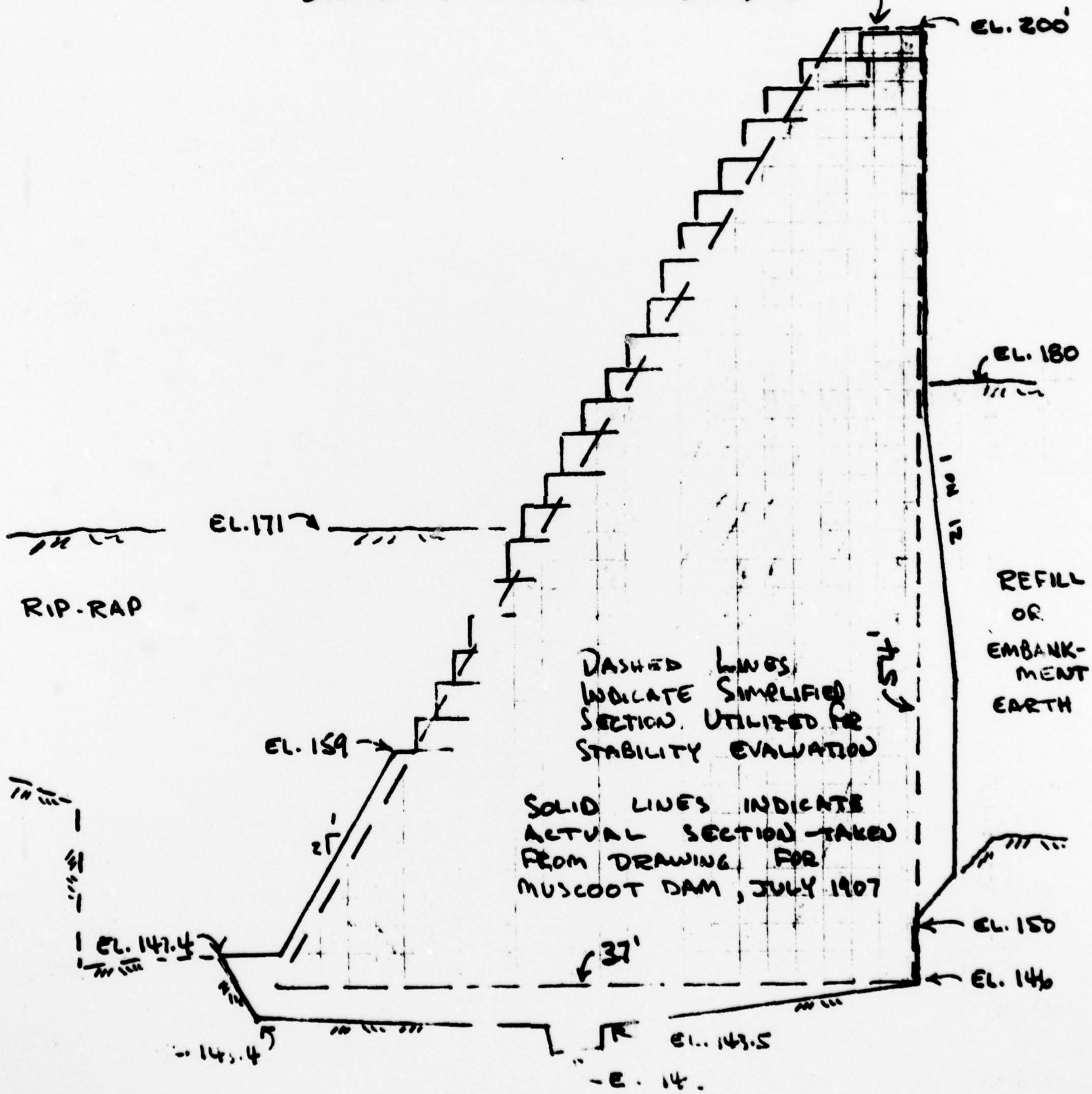
		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	0	182441.	181029.	129812.	55914.	315.00
ROUTED TO	0	183790.	178585.	129495.	55809.	315.00

APPENDIX D

STABILITY ANALYSIS

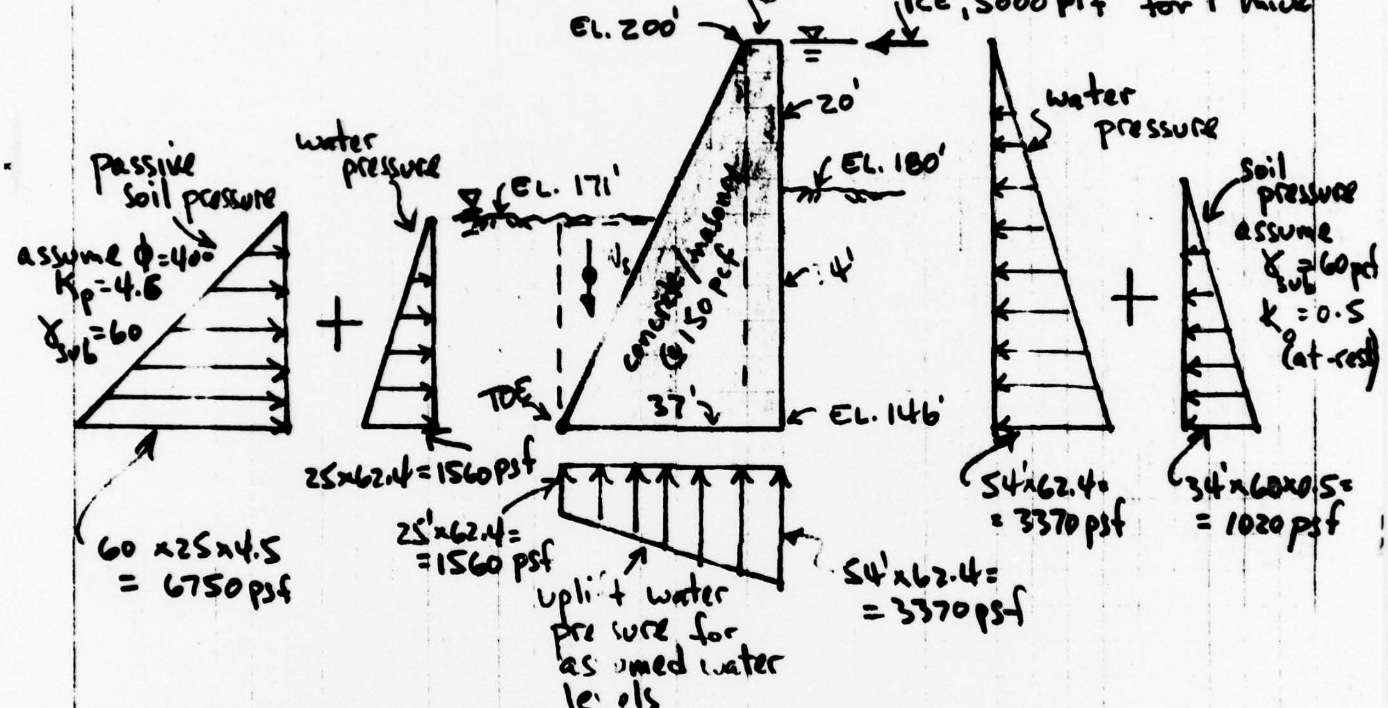
MUSCOOT DAM - SECTION TAKEN FROM GENERAL PLAN & SECTIONS DATED JULY 1907

SECTION INDICATED FOR STA. 3+10



STABILITY – OVERTURNING & SLIDING

I. Assume following conditions (severe)
- WL and ice at top of dam (EL. 200')
- downstream WL @ ground level (EL. 171')



A. OVERTURNING

Forces causing overturning about toe ~ horiz. water pressure + horiz. soil pressure + ice + uplift pressure.

Moments about toe:

Soil pressure $= \left(34 \times 60 \times 0.5 \times \frac{34}{2} \times \frac{34}{3}\right) = 197{,}000$ '#

horiz. water press. $= \left(54 \times 62.4 \times \frac{54}{2} \times \frac{54}{3}\right) = 1{,}634{,}000$ '#

ice $= (5{,}000\# \times 54') = 270{,}000$ '#

uplift water press. $= \left(1560 \times 37 \times \frac{37}{2}\right) + \left(1810 \times \frac{37}{2} \times \frac{2}{3} \times 37\right) = 1{,}894{,}000$ '#

Total $= 3{,}995{,}000$ '# (causing overturning)

Forces resisting overturning about toe ~ mass of dam + horiz. water pressure (downstream) + horiz. soil pressure + weight soil above toe of dam

Moments about toe:

mass of dam $= (32' \times 54' \times \frac{1}{2} \times 150\text{ pcf} \times \frac{2}{3} \times 32) +$

$+ (5 \times 54 \times 150\text{ pcf} \times 34.5') = 4,162,000$ #

soil above toe $= (15' \times 25' \times \frac{1}{2} \times 60\text{ pcf} \times 5') = 56,300$ #

horiz. soil pressure (passive) $= (25' \times 60\text{ pcf} \times \frac{1}{2} \times 25 \times 4.5 \times 4.6) = 703,000$ #

horiz. water press. $= (25 \times 62.4 \times \frac{25}{2} \times \frac{25}{3}) = 163,000$ #

Total = 5,0[illegible],300 # (resisting ovt)

FS against overturning $= \frac{5,0[illegible],300}{3,9[illegible],000} = 1.27 \pm$ (with uplift)

$= \frac{5,0[illegible]}{2,115000} = [illegible].40 \pm$ (no uplift)

B. SLIDING

Forces causing sliding ~ horiz. soil press. + water pressure

$= (34 \times 60 \times 0.5 \ \frac{34}{2}) + (54 \times 62.4 \times \frac{54}{2}) = 108,300$ #

Forces resisting sliding ~ soil and water press. acting horizontally + friction along base of dam

horiz. soil press. $= (25 \times [illegible]0 \times 4.6 \times \frac{25}{2}) = 85,000$ #

horiz. water press. $= ([illegible]2.4 \times 25 \times \frac{25}{2}) = 19,400$ #

friction at base = f(downward weight − uplift) =

$= (0.6)\left[(\frac{32 \times 54}{2} \times 150\text{ pcf}) + (5 \times 54 \times 150) + (15 \times 25 \times \frac{1}{2} \times 60) - \right.$

$\left. - (91,000\ \#\ \text{uplift})\right] = (0.6)[90,000\#] = 54,000$

FS against sliding $= \frac{85.0 + 19.4 + 54.0}{108.3} = 1.5 \pm$ (no ice)

$= \frac{158.4}{113.3} = 1.4 \pm$ (with ice)

(CONTD) D⇒

C. OVERTURNING (NO UPLIFT, OTHER CONDITIONS AS BEFORE

moment causing overturning = 195 + 1,650^{1K} + 270^{1K} = 2,115^{1K}

moment resisting overturning = [illegible]300^{1K}

FS against overturning = $\frac{[illegible]}{2\ [illegible]000}$ = 2.4 ±

II. Stability for condition where upstream reservoir is drawn-down 5 ft. in winter, with ice and uplift acting

A. OVERTURNING

Overturning moments:

soil pressure behind dam = 197,000 '#

horiz. water pressure = $\left([illegible]9 \times 62.4 \times \frac{49}{2} \times \frac{49}{3}\right)$ = 1,224,000 '#

ice = 5000# × 49' = 245,000 '#

uplift water pressure = $\left(1560 \times 37 \times \frac{37}{2}\right) + \left(1500 \times \frac{37}{2} \times \frac{2}{3} \times 37\right)$ = 1,751,000

Total = 3,417,000 '#

Resisting Moments:

as for (I) = 5[illegible] 3[illegible] '#

FS against overturning = $\frac{[illegible]}{3,417000}$ = 1.49 ± (with uplift)

= $\frac{[illegible]}{1\ 660000}$ = 3.06 ± (no uplift)

(CONTD)

III. Overturning Stability for condition where downstream reservoir is 10' below top of dam, upstream reservoir to top of dam

Overturning Moments

soil pressure behind dam = 195,000 '#

horiz. water pressure = 1,650,000 '#

ice = 270,000 '#

uplift pressure $= \left(2740 \times 37 \times \frac{37}{2}\right) + \left(630 \times \frac{37}{2} \times \frac{2}{3} \times 37\right) = 2,070,000$ '#

Total = 4,185,000 '#

Resisting Moments

mass of dam = 4,16[illegible],000 '#

soil above toe = 56,500 '#

horiz. soil pressure (passive) = 7[illegible]3,000 '#

horiz. water press $= \left(6[illegible].4 \times 44 \times \frac{44}{2} \times \frac{44}{3}\right) = 886,000$ '#

Tota[illegible] = [illegible],8[illegible],5[illegible] '#

FS against overturning

$$= \frac{5.8[illegible]}{4.185} = 1.4 \pm \quad \text{(with uplift)}$$

$$= \frac{5.8}{2.115} = 2.75 \pm \quad \text{(no uplift)}$$

(CONT'D)

APPENDIX E

REFERENCES

APPENDIX E

REFERENCES

1. Department of the Army, Office of the Chief of Engineers. National Program of Investigation of Dams; Appendix D: Recommended Guidelines for Safety Inspection of Dams, 1976

2. Edward Wegmann: The Design and Construction of Dams, John Wiley and Sons (1918)

3. Charles H. Weidner: Water for a City - Rutgers University Press (1974)

4. The University of the State of New York - The State Education Department - State Museum and Science Service - Geological Survey: Geological Map of New York (1970)

5. John F. Cowan: Report to the Aqueduct Commission 1895-1907

6. U.S. Nuclear Regulatory Commission: Design Basis Floods for Nuclear Power Plants, Regulating Guide 1.59, Revision 2, August 1977

7. Water Resources Engineers, Inc., Lower Hudson River Basin, Hydrologic Flood Routing Model, January 1977

8. Linsley and Franzini: Water Resources Engineering, Second Edition, McGraw-Hill (1972)

9. Louis C. Schreiner and John T. Riedel: Hydrometeorological Report No. 51, U.S. Department of Commerce, National Oceanic and Atmospheric Administration National Weather Service, Office of Hydrology; Silver Springs, Maryland, September 1976

10. Ven Te Chow: Handbook of Applied Hydrology, McGraw-Hill, 1964

11. The Hydrologic Engineering Center: Computer Program 723-X6-L2010, HEC-1 Flood Hydrograph Package, User's Manual, Corps of Engineers, U.S. Army, 609 Second Street, Davis, California 95616, January 1973

12. The Hydrologic Engineering Center, Art Pabst: Computer Program UHCOMP, Unpublished, Corps of Engineers, U.S. Army, 609 Second Street, Davis, California 95616

13. North Atlantic Regional Water Resources Study Coordinating Committee: Appendix C, Climate, Meteorology and Hydrology, February 1972

14. Soil Conservation Service (Engineering Division): Urban Hydrology for Small Watersheds, Technical Release No. 55, U.S. Department of Agriculture, January 1975

15. H.W. King, E.F. Brater: Handbook of Hydraulics, McGraw-Hill, 5th Edition, 1963

16. Ven Te Chow: Open Channel Hydraulics, McGraw-Hill, 1959

17. Bureau of Reclamation, United States Department of the Interior, Design of Small Dams: A Water Resources Technical Publication, Third Printing, 1965

18. The Hydrologic Engineering Center, Regional Frequency Studies Upper Delaware and Hudson River Basins, New York District, November 1974

19. "Permeability Pore Pressure, and Uplift in Gravity Dams", by Roy W. Carlson, Transactions ASCE, Volume 122, 1957

20. Prucha, J.J. 1959, Field Relationships Bearing on the Age of the New York City Group of the Manhattan Prong: New York Academy of Sciences Annals, Volume 80, Article 4, Pages 1159-1169

21. Scotford, David M., 1956, Metamorphism and Axial-Plane Folding in the Poundridge Area, New York: Geological Society of America Bulletin, Volume 67, Pages 1155-1198

22. Preliminary Brittle Structures Map of New York, New York State Geological Survey, 1977